Chapter 1 - Background

1.1 Purpose of the research

The purpose of this research can be divided into four main objectives:

- The first objective of this project is an investigation into the South African Aviation industry, with reference to the technology transfer activities and the resulting strategies.
- The second objective is to investigate the mechanisms used in the transfer process.
- The third objective is to focus the role-players in the South African industry's attention on the important role technology can play in their industry.
- The final objective is to introduce the technology transfer process and provide a model that describes this transfer process. The model identifies the main activities involved in technology transfer and can be used as a measuring tool, for output or for the progress of the transfer project.

Similar studies have been done internationally and in other industries. No similar studies however, have been done specifically in the South African Aviation Industry. The feeling is that not enough emphasis is placed on technology and the role technology can play in creating a competitive advantage. Technology underlies every business area and a company will have a clear disadvantage when competing against new technology. This is especially true for highly competitive industries like the aviation industry. It becomes even more important when one remembers that South Africa only recently entered the international arena and concepts like competition, profit and competitive advantage, are becoming increasingly important. Technology is underlining every aspect of the modern business. Therefore each organisation should have a thorough knowledge of technology relevant to their organisation. The benefit of transferring appropriate technology may

result in an increased market share and higher growth rates. Technology can also provide a competitive advantage.

1.2 Technology Transfer

The purpose of this section is to define exactly what 'technology transfer' means. Let us start with the concept, 'technology'. For the purpose of this investigation 'technology' is defined as "specialised knowledge applied to achieve a practical purpose". In other words, scientific knowledge is applied to develop a product or service in order to satisfy an existing or new need. Technology is therefore the culmination of intellectual and physical ingenuity, in order to augment human skill[1]. It is clear that knowledge forms a very important component of technology. In fact, if knowledge is removed, you do not have technology anymore[2].

The second concept is 'transfer'. For the purpose of this investigation, transfer not only retains its defined meaning of "moving something to another location", but also includes the use of the transferred item. This concept is illustrated by the following example. If a computer program is bought, the intended functionality has not been transferred to the buyer of the programme. Even if the programme is installed, the functionality has not been transferred. Only when the buyer uses the programme, then certain functionality has been transferred.

Technology transfer therefore means movement of technology, consisting of knowledge, skills and equipment, from an originator's environment to a user's environment. No transfer has however taken place unless the transferred technology is used.

Technologies can be found in a wide range of business areas like manufacturing, marketing, customer service, etc. This investigation will focus on the technologies used in the maintenance function.

1.3 The Aviation Industry

Since 1994 major changes have taken place in South Africa. These changes have affected many industries and the South African aviation industry, is no exception. In a very short period of time new markets have opened that were previously inaccessible, and a number of foreign operators have extended their services to South Africa. Subsequently, Johannesburg International Airport has become the largest airport in Africa in terms of the number of passengers and amount of cargo handled annually.

In the past the aviation industry was forced to be self-sufficient and to operate without any assistance. This effected most areas inside the aviation industry, including the maintenance function. Parts necessary to service aircraft were not always available and skills were developed to repair most parts used on the aircraft. Very unique skills were developed during this time in order to ensure the availability of aircraft. Due to the unique circumstances, company cultures were established, which could be described by an attitude of 'we can do anything' and this was necessary in order to survive and continue operations.

The major role players in the South African aviation industry were state-owned and profit was not the main objective of these companies. Concepts like 'competition' and 'competitive advantage' did not receive the same attention as in companies operating in an open market. Many international carriers were not allowed to operate routes to South Africa and this limited the competition that South African carriers faced. It is clear that the industry functioned in an artificial market, where the market forces were different from what is traditionally expected. Companies in the industry became large organisations, which incorporated every aspect of the aviation industry 'under one roof'. The reason being that it was expected of these companies to be self-sufficient and diversified enough to handle anything. Traditional sources of technology were not available/accessible and this resulted in the heavily relying on their skills and customised knowledge to keep the operations going.

This all changed after 1994 when South Africa was accepted back into the world community. One of the first industries to be exposed to the new dispensation was the aviation industry, as a result of the nature of its service, namely transporting passengers and cargo nationally and internationally. Suddenly the industry experienced competition because large international carriers were allowed to service South African routes. The South African industry was forced to re-evaluate its position and no longer had to be self-sufficient, but had to be competitive in a global market. Even individual functions like 'maintenance' had to re-evaluate their position and objectives, as they too were faced with direct competition. The industry also started with privatisation talks and suitable international carriers were sought as partners. Time and cost began to play a more important role, as these are competing factors in international competition. The industry also started to follow international trends in a bid to become more competitive. Airlines started to focus on their core business of transporting passengers and goods, while outsourcing other functions like maintenance. Sources of technology also started to open up and become more accessible.

The military industry too began to move away from the way things were done in the past. Maintenance, for instance, began changing from a mainline function to a support system. Because of the relative small local market and an industry that requires very specialised skills, many specialised tasks will in future be outsourced. This is due to the fact that it is expensive to retain these specialised personnel and a company is not able to fully exploit the specialised skills of the workforce, because the skill is only needed once or twice a year. In short there is not enough work to employ a specialist and train him/her for a specialised procedure.

The support system being implemented by the military industry, aims to ensure mission-ready and mission-capable aircraft. In order to reach this objective, the following four main functions were identified:

- Mission preparation

- Servicing
- Repair
- Mission functionality

Mission preparation

Before each flight (mission) the support system ensures that the aircraft will be able to complete the flight and accomplish all its mission goals. Third party involvement will be restricted to optimisation of this function regarding its cost-effectiveness.

Servicing

This includes the traditional functions associated with servicing parts and aircraft. Outsourcing will play a bigger role in the function of servicing.

Repair

This includes the repair of components and aircraft with much of the work being outsourced.

Mission functionality

Military aircraft are used as platforms to fulfil many different functions. Outsourcing will not play a major role in this function.

In order to execute the support system effectively, knowledge of the product is necessary up to a certain level, in order to complete certain tasks. The military aviation industry has therefore defined the level of knowledge needed for each function, in order to perform their work effectively. In Table 1.1 the level of knowledge on a scale of 1 to 10 required, for each task is indicated. One on the scale of the knowledge base (KB) indicates 10 % of the total knowledge of the system, while 10 indicates 100% knowledge of the whole system. In Table 1.1 it is indicated that between 10% and 20% knowledge of the whole system is needed, in order to operate the system effectively. By defining the knowledge needed to complete a task successfully, 'redundant' knowledge

can be removed from the support system. Tasks that fall outside the current knowledge base are outsourced. This is a good way to manage knowledge.

Task	Description	KB
Operate	All activities, procedures, processes and resources required to operate a product.	$1-2$
Measure	All activities, procedures, processes and resources required to measure the performance of a product.	$1-3$
Maintain	All activities, procedures, processes and resources required to maintain a product.	$2-6$
Analyse	All activities, procedures, processes and resources required to analyse a product.	$4-7$
Change (physical)	All activities, procedures, processes and resources required to change a product. Functional requirements remain the same, while form and fit might change.	$6-7$
Change (functional)	All activities, procedures, processes and resources required to operate a product. This entails both functional and physical change.	$7-8$
Re-Specification	All activities, procedures, processes and resources required to re-specify a product. Re-specification will lead to re-design, including both physical and functional change	$8-10$

Table 1.1: Knowledge Base

It is clear that the civil and military aviation industries are adapting to a new environment with different forces and they are utilising new strategies. This is necessary, because they face new challenges each day and in order to survive in a competitive market, new innovative ideas are needed.

1.4 Overview

The objective of the overview is to serve as a guide for the various chapters. It includes the motivation for each chapter and a short description of the contents.

1.4.1 Chapter 2 - Technology Transfer

Chapter 2 describes in detail all the aspects involved in the technology transfer process. This is an in- depth look at the theory behind the transfer of technology. Some tools are presented in this chapter, which may help in aspects like determining the technology portfolio of an organisation. The chapter is concluded with an example of a technology transfer project between two companies.

1.4.2 Chapter 3 - Knowledge Transfer

Chapter 3 covers some aspects concerning the transfer of knowledge. As we enter the knowledge age, knowledge is becoming an increasingly important aspect of technology. This is the motivation for this chapter and some aspects in the transfer of knowledge are highlighted. Two models are presented, which describes some of the aspects involved in the knowledge transfer process.

1.4.3 Chapter 4 - The Aviation Industry

Chapter 4 is divided into three parts. The first part looks at maintenance and factors that influence maintenance. The second part presents trends in the aviation industry. The leaders in the industry set these trends. The trends are divided into the four main areas namely: training, collaboration, maintenance and outsourcing. The third part of Chapter Four presents technological developments in the aviation industry. Some of the technologies used in the

aviation industry are presented in this section together with the latest technological advancements.

1.4.4. Chapter 5 - Research

Chapter 5 describes the research that was conducted in the industry. This chapter starts off with the research problem and a number of hypotheses. The research methodology is then presented, followed by the results and the discussion of the results.

1.4.5   Chapter 6 - Transfer Model

Chapter 6 describes the newly proposed model. The aim of the model is to identify the major aspects involved in the technology transfer process. This model may act as a guide in assisting people involved in the management of technology, especially in the area of technology transfer. The model identifies all the phases in the transfer process and indicates how the project moves through these phases.

1.4.6   Chapter 7 - The future

Chapter 7 is a look into the future. It describes a possible scenario of what the future may hold for the Aviation industry. The aim of this chapter is to introduce possible scenarios to the major role players in the industry, and to stimulate thinking into what technologies may be used in the future.

1.4.7   Chapter 8 - Conclusions and Recommendations

Chapter 8 contains the conclusion based on the previous chapters as well as recommendations on possible future research.